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(54) Gymnastic machine

(57) Gymnastic machine (1)(101) in which a load unit (20)(120) and an exercise station unit (30)(130) are arranged side by side to exchange energy; the load unit (20)(120) having at least one arm (35)(135), carried rotatably by a frame (10)(110) around a fixed shaft (36) (136), and an implement (40)(140) coupled rotatably to the arm (35)(135); each implement (40)(140) being movable over an open trajectory (P) and shaped in such a way as to be interfaceable with a particular portion of

an extremity of a user; the exercise station (30)(130) including at least one articulated mechanism (43)(153) 154) suitable for controlling the rotation of the corresponding implement (40)(140) with respect to the corresponding arm (35)(135), in such a way that each implement (40)(140) is, in use, inclined inwards on the outward thrust stroke of the relative arm (35)(135), and simultaneously rotated forward, so as to lower a respective front section (44)(144), and raised as regards a respective rear section (45)(145).

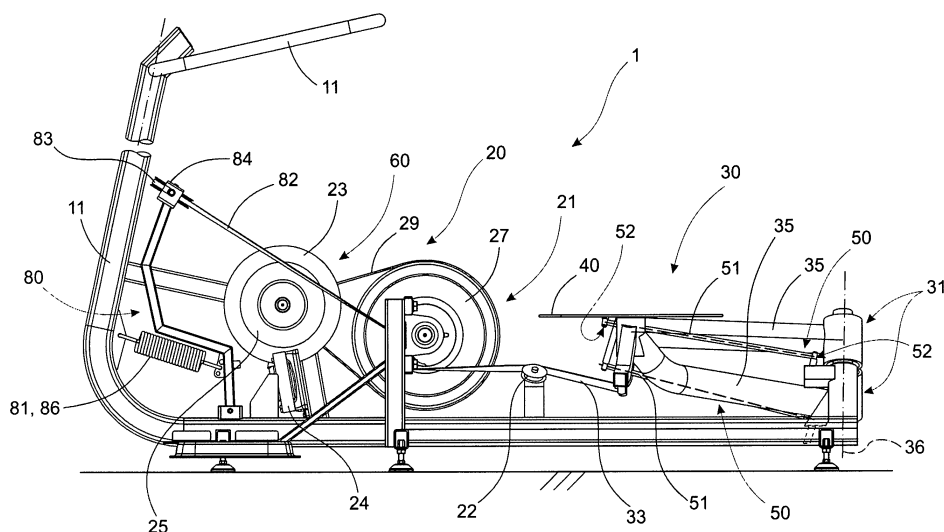
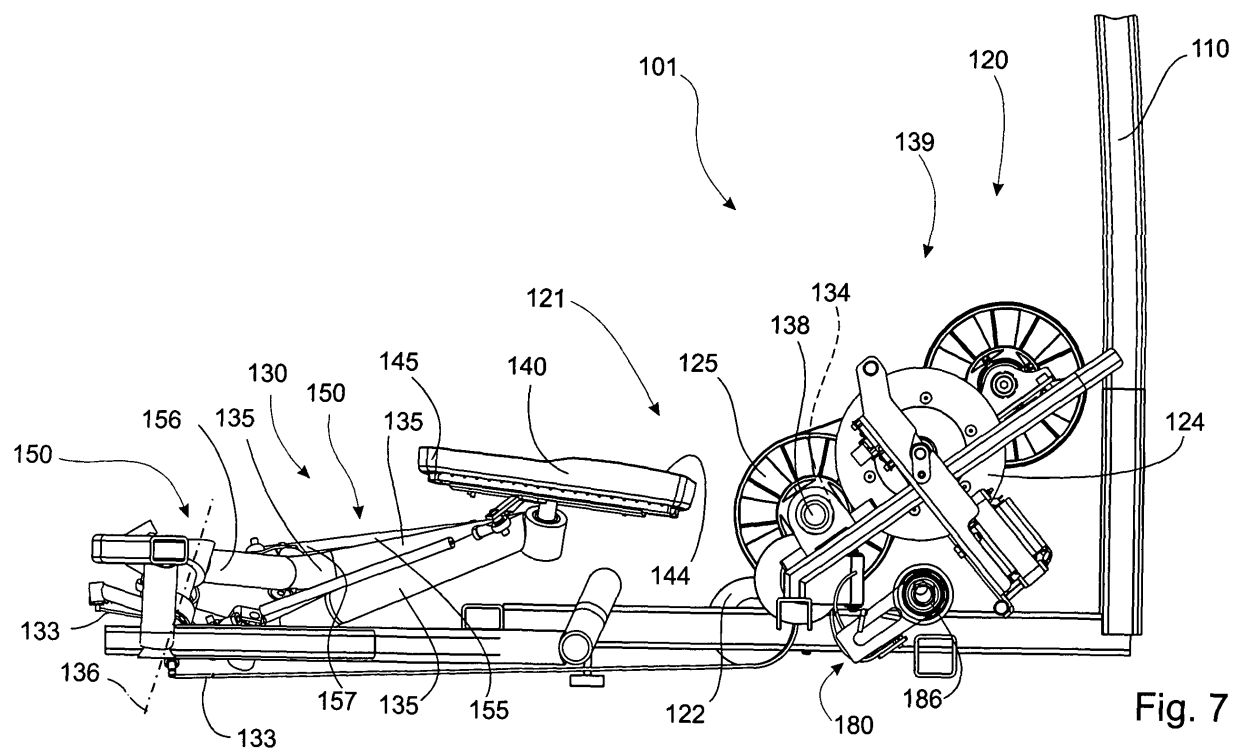


Fig. 1



Description

[0001] The present invention relates to a machine effectively usable for executing physical exercises. In general, this invention can have application both in gymnastic machines aimed principally at muscular development, and in machines suitable for the execution of training of the cycling type, and therefore aimed principally at the development of resistance to prolonged exertion. In more detail the present invention relates to a gymnastic machine having at least one implement usable for the repeated execution of alternating movements over an open trajectory.

BACKGROUND OF THE INVENTION

[0002] In the field of gymnastic machines there are well-known machines for the execution of exercises which involve/recruit a single muscle area; machines for the execution of exercises which recruit several muscle areas simultaneously or in succession, and for this reason are designated "functional"; and machines which enable the development of resistance to prolonged muscular exertion, by means of which it is possible to perform repetitive aerobic/cardiovascular exercises. Normally, machines of the first type are equipped with load units with counterweights, in which the exercise provides for a succession of eccentric and concentric efforts, while machines of the second type are equipped with load units which can exchange energy with the user continuously while he/she carries out a cyclical movement without break in continuity. Among the latter, the most widespread are stationary bicycles, treadmills for walking or running, so-called "steppers" for simulating a route with steps, and elliptical machines for walking and/or running on mobile footboards on closed elliptical trajectories.

[0003] Stationary bicycles, steppers and elliptical machines have load units designed to operate by absorbing the power exerted by a user, while treadmills may be either of the type actuated by a user, or motorised with an actuator which determines the delivery of power by the user. Steppers, also, are of the 'floating' type, in the sense that the power transmitted to the load unit during the operation of the footboards determines the average height of the user's centre of gravity with respect to the base of the machine, and therefore influences the amplitude of the movement.

[0004] Among cyclical training machines, skating simulators are also well-known. Among these, simulators produced in implementation of US patent 5,718,658 are particularly widespread. According to the specifications in this patent, a skating simulator may have a pair of substantially identical arms side by side, pivoting on vertical axes; each arm carries a footboard which pivots on it near one relative free extremity; each footboard has a transverse strip designed to prevent transverse slippage from the footboard itself, and therefore for restrain-

ing the relative foot. Each lever acts on a flywheel by means of a mechanical transmission fitted with a belt, which is wound along its route round a free wheel, to cooperate with the flywheel, and is connected at its respective extremities to a lever and to the frame, and at this end the connection is made through the interposition of a spring. Each lever is therefore braked in rotation by a belt, and the return of the levers to a central rest position is effected by the respective spring.

[0005] This machine concept presents several disadvantages: first of all the sensation of unease which seizes the user who finds him/herself lifted off the ground on two footboards supported by very long activating levers; secondly, the user's feet are kept oriented forwards during the displacement of the arm from the rest position, substantially central, to a distal position. For this reason, the user's ankles are subjected to unnatural movements, and the feet find themselves acting in a different way from that in which they really operate in the skating movement. In the case of particularly large movements this can cause a user to lose balance above the levers, with results which are hard to predict.

[0006] To remedy some of the above disadvantages, it is possible to refer to the specifications presented in US patent application no. 2002/0042329, in which each footboard is supported bilaterally by an incurved prismatic guide. This guide-footboard pair, besides determining the shape of the trajectory of the said footboard, is shaped in such a way as to vary the inclination of its upper face used by the foot of a user. This guide-footboard pair, therefore, is arranged so as to increase the grip between foot and footboard during the execution of the thrusting movement, and thus offer the user greater safety in executing the movement of each foot outwards. The load unit of the machine which embodies the specifications of the application in question also has a flywheel which can be activated by means of a freewheel coaxial with it. In addition, an elastic return device is provided to bring the footboards back to the relative central position. In particular this return mechanism is provided, for each footboard, with a flexible component including a belt and a spring arranged in series and running round pulleys.

[0007] However, an inventive concept of this type appears to be improvable in several aspects, given that the presence of a guide/slide pair, if fitted with rotatable rollers, entails high production costs owing to the necessity of producing accurate guide/slide pairs, and significant wear problems, which reflect negatively on the costs of operation because of the need to carry out frequent adjustments to the pair. Furthermore, the extreme rigidity of the structure causes low flexibility of adjustment of the amplitude and angle of the footboard while carrying out the movement, given that these dimensions are directly connected with the length of the user's limbs.

[0008] It should be noted that, in virtue of what is described above, both inventive concepts record the case in which each individual footboard is freely operable,

and this allows the relative load unit to be operated by a single footboard at a time or both footboards simultaneously. This is of particular advantage to users more expert in the skating movement, or those better endowed from a muscular and balance point of view.

[0009] In virtue of what is described above, the machine concepts which embody the specifications of US patent 5718658 and of patent application 0042329 appear improvable both because of the fact that the type of movement which can be executed does not represent a simulation of the skating movement, and because the machines which embody these specifications are poorly adaptable to the anthropometric dimensions of users of different heights, and because of the fact that these machines are very cumbersome, barely effective and very costly, while the users demand the production at reasonable cost of compact gymnastic machines which are usable for strengthening the muscles typically involved in the skating movement.

SUMMARY OF THE PRESENT INVENTION

[0010] In general, the present invention relates to a machine effectively usable for executing training exercises. In particular, this invention can have application both in gymnastic machines aimed principally at muscular development, and in machines set up for the execution of training of the cycling type, and therefore aimed principally at the development of resistance to prolonged exertion. In more detail the present invention relates to a gymnastic machine having at least one implement usable for the repeated execution of alternating movements over an open trajectory.

[0011] The object of the present invention is to construct a gymnastic machine on which it is effectively possible to carry out training which simulates the skating movement.

[0012] A further object of the present invention is to allow a user to have available a central support while carrying out the actuation of a footboard outwards, in such a way as to make the machine usable indifferently by users who already have practice in the skating movement, and by users who are not practised in this movement.

[0013] A further object of the present invention is to construct a machine for the simulation of skating which is of limited overall dimensions in relation to the extent of the movement which can be carried out on it, and with limited costs of purchase and of operation.

[0014] According to the present invention a gymnastic machine is constructed whose characteristics are described by reference to claim 1 and following.

BRIEF DESCRIPTION OF DRAWINGS

[0015] The invention will now be described by reference to the annexed drawings, which illustrate some non-limiting examples of its embodiment, in which:

- Figure 1 is a schematic view in lateral elevation of a first preferred embodiment of the present invention;
- Figure 2 is a rear schematic view on an enlarged scale and with parts removed for clarity, of the machine in Figure 1, illustrated in an operating position useful for illustrating some of its structural characteristics;
- Figure 3 is a schematic perspective view, on an enlarged scale and with parts removed for clarity, of the machine in Figure 1;
- Figure 4 illustrates a structural diagram of a second preferred embodiment of a first particular device of the machine in Figure 1;
- Figure 5 illustrates two diagrams of two further preferred embodiments of second particular devices of the machine in Figure 1;
- Figure 6 is a diagram derived from Figure 1 in which the machine is illustrated in a particular operating position, with the relative implements arranged side by side in their respective rest positions;
- Figure 7 is a view in lateral elevation of a third preferred embodiment of Figure 1;
- Figure 8 is a view on plan, with parts removed for clarity, of Figure 7;
- Figure 9 is a view in longitudinal section, on an enlarged scale, of a detail taken from Figure 8;

DETAILED DESCRIPTION OF AT LEAST ONE EMBODIMENT OF THE PRESENT INVENTION

[0016] In Figure 1, no.1 indicates, in its entirety, a gymnastic machine having a frame 10 which supports a load unit 20 and an exercise station 30 arranged side by side. This station 30 is capable of exchanging mechanical energy with load unit 20 and has at least one pair 31 of mechanical components articulated together, among which are an arm 35 carried rotatably by the frame 10 around an axis 36 inclined with respect to the vertical, and an implement 40 shaped so as to be interfaceable with a particular portion of an extremity of a user and coupled to said arm 35 at its extremity in freely rotatable manner. For example, in figure 2, it may be seen how, for safety reasons, the footboard has an upstand 42 in the relative central section, capable of functioning as a buffer for the other footboard 40, and capable of preventing direct impacts between the malleoli of the feet of a user, or similar problems connected with possible interference during the use of the machine 1. Implement 40 is therefore rotatable on its own axis and movable over a curved and open trajectory P, visible in Figure 2, in which it is represented by a dashed and dotted line. This trajectory P, which will be more fully described below, is laid out around axis 36, and inclined downwards in such a way that each implement 40 is movable starting from a higher level corresponding to a longitudinal plane L on the centreline of the machine 1 itself and a lower level located to the side.

[0017] Here and below, for pure convenience, a preference is made for referring to the concrete case of a machine 1 employable for the simulation of the skating movement, without this choice necessarily being interpreted as an implicit limitation of the applicability of the present inventive concept to gymnastic machines usable for the execution of other forms of training than that of skating. In line with what has been stated, machine 1 has two pairs 31 arranged side by side and located on opposite sides of plane L, fully analogously with what occurs in the known machines for simulating the skating movement. A preference is therefore made for assigning implement 40 the designation of footboard 40. Plane L is visible by reference to Figure 2.

[0018] Again for reasons of convenience, it has been preferred not to complicate the annexed drawings and the present description with the addition of a device, known and not illustrated, for the command and control of the machine 1, a device which is normally indicated by the term "console", referring to the casing which contains it. In fact, notwithstanding that such a console normally has instruments for regulating particular functional aspects of the machine connected with physiological parameters of the user, the description of such a device would have added nothing to the inventive content of the present invention.

[0019] Exercise station 30 includes, for each pair 31, at least one extended component 51 limited longitudinally by spherical couplings 52, each one of which links component 51 to frame 10 and to the said footboard 40. In particular, the spherical coupling which links component 51 to the frame is placed to the side of the axis of rotation 36 of arm 35, therefore this component 51 is capable of constraining the rotation of each footboard 40 relative to the respective arm 35 in such a way as to control in rotation a foot resting on a face 41 of the said footboard 40 with respect to the corresponding arm 35. In case it is necessary to adapt the behaviour of footboard 40 to the needs of the user, component 51 can also have a length adjustable at will. This has the effect that each foot of a user is supported by the corresponding footboard 40 in matching/bilateral manner along an open and circular trajectory P, both on the thrust stroke and on the return stroke to a rest position R of the footboard 40 alongside plane L. In virtue of what is described above, this occurs even when this trajectory P is inclined downwards in its relative outward part, for the purpose of increasing the safety of machine 1 for careless or inadequately trained/skilled users.

[0020] On the basis of what has been described above, each footboard 40 connects together the relative component 51 and the relative arm 35, and both are connected rotatably to frame 10. Footboard 40, therefore, which connects arm 35 and the respective component 51 in relatively rotatable manner is capable of functioning as a lever, and the assembly of each pair 31, the frame 10, and the respective component 51, besides forming an articulated quadrilateral 43, can be interpreted

ed as a constraining device 50, capable of controlling the rotation of implement 40 relative to the respective arm 35. This quadrilateral 43 constrains face 41 of footboard 40 in such a way that a foot placed on top of footboard/lever 40 is guided in space along a composite trajectory in conditions of contact and relative rest with face 41, by means of the combination of rotation movements around axis 36. In virtue of what is described above, each component 51 is capable of producing a composite movement of the respective footboard 40 and in particular of inclining the respective footboard 40 inwards on the outward thrust stroke of the relative arm 35, and simultaneously of rotating footboard 40 forwards, to lower its front section 44 and raise its rear section 45. The inclination of footboard 40 inwards reduces varus of the knee and favours the stability of the ankle in the lateral thrust, while the forward inclination of the footboard favours the stabilisation of the user's centre of gravity over the foot which remains in the central position. In the event that footboard 40 were to remain parallel to itself, the user would have to displace his/her centre of gravity on the rearward thrust stroke, weakening the capacity of the leg left in a forward position to provide support. This also allows the sole of each of the user's feet to remain substantially perpendicular and at rest with respect to an upper face 41 of the relative footboard 40, and therefore constantly fitting this face 41. In this way, it will be possible to fully exploit the movement imparted by the user to arm 35 in full respect of joint biomechanics, with the result that the thrust produced will be the maximum producible by a user in full dynamic equilibrium. In addition, this therefore makes optional the recourse to a holding component capable of embracing at least one transverse portion of the foot, and thus allows the construction of the individual footboards to be simplified, with the added advantage of a reduction in cost. By transference, the compound movement of footboard 40 may also be summed up by the term 'eversion movement', because of the affinity which this movement has with the movement of flexion and pronation which the sole of a foot can execute when the relative leg is maintained in a static condition. At all events, it may be stated that, in use, moment by moment, while footboard 40 rotates with respect to axis 36 of the relative arm 35, the two couplings 52 behave as couplings instantaneously rotoidal and skew to each other.

[0021] The layout of both arms 35 across the longitudinal median plane L has significant advantages from the point of view of bulk and functionality for machine 1 as a whole, given that it allows stations 30 to be constructed to small dimensions. In addition, each trajectory P is as a result more respectful, for a given length of the relative arm 35, of the biomechanics of the lower limbs of a user, and in particular of the ankle and the foot, by comparison with the case in which the footboard and its axis 36 are arranged on the same side of plane L. Furthermore, this allows a user to deliver a substantially constant power during the execution of the outward

movement of the leg and the relative foot, and in particular in the zone of trajectory P which corresponds to the term 'eversion movement' of the foot, as described above. It should however be borne in mind that the particular conformation of arms 35 allows a user to bring each footboard 40 onto the same side of plane L as the one on which its respective axis is located, in particular conditions of operation, to suit the skating style of each user. Lastly, it is clear that, as is seen in Figure 2, arms 35 are shaped dissimilarly to each other in such a way as to prevent collisions between arms 35 or between footboards 40 during use of the machine 1. The same goes for arms which carry stops 37 for each arm 35.

[0022] It is as well to observe that, notwithstanding that trajectories P traced by the footboards are necessarily symmetrical with respect to plane L, given that machine 1 is usable for the training of the lower limbs, which are normally symmetrical, arms 35 must be shaped dissimilarly to each other, in order to prevent possible interference with each other. Pairs 31 are therefore asymmetrical, and each arm 35 is supported by its own shaft 36 on the opposite side with respect to plane L from its respective footboard 40, and is operable in this segment of space starting from its respective position of rest R. It should also be noted that trajectories P of footboards 40, besides being circular and centred on shafts 36, can have at least one stretch of minimal length in common, in the area of plane L. In the case of machine 1, the particular geometrical configuration of arms 35 and the orientation of their respective axes 36 determines the fact that trajectories P of footboards 40 intersect at one point, which is geometrically positioned corresponding to plane L.

[0023] According to Figures 1 and 3, unit 20 includes a rotatable component 25 shaped in such a way as to be suitable for storing rotational energy, typically a flywheel 25, which is supported by the frame 10 by means of a shaft, known and not illustrated, which carries keyed to it a disc 23 of an electromagnetic brake 24 capable of dissipating adjustable amounts of power in continuous fashion. Machine 1, furthermore, has between load unit 20 and exercise station 30 a mechanical transmission 21, capable of transforming an alternating rotary motion of each arm 35 into a rotation of flywheel 25. This transmission 21 includes an idle wheel 27 which is keyed in cantilever onto a horizontal shaft 38 which is carried by frame 10 between two supports which are visible together only in Figure 2. This wheel 27 is capable of rotating in phase with flywheel 25 by means of a belt 29 and a pinion 32, coaxial with the said flywheel 25. Transmission 21, furthermore, includes at least one belt 33 for each arm 35, and each belt 33 is wound round a plurality of pulleys 22, supported by frame 10 in freely rotatable manner to connect a corresponding arm 35 and a free wheel 34 in load unit 20. Each wheel 34, which as is known is capable of transmitting torque in one direction only, while it is capable of rotating idly if activated in the opposite direction, is keyed onto shaft

38 to transmit motive power to flywheel 25 by means of belt 29 of transmission 21. Accordingly, each footboard 40, and the corresponding arm 35, can be activated independently of the condition of motion or rest of the other footboard 40, even though, as will be seen below, it is possible to think of constraining the rotation of footboards 40 by means of that of the relative arms 35.

[0024] It is appropriate to point out that the type of load unit 20 can vary in relation to the type of training which it is intended to carry out on the said machine 1, and in particular aerobic/cardiovascular or muscular/anaerobic. Accordingly, unit 20 can be of electromagnetic type and include brake 24 as in Figures 1 and 3, if it is intended to carry out training of aerobic type, or unit 20 can be of mechanical type and have at least one device 70 with counterweights for muscular/anaerobic training, as illustrated in the diagram in Figure 4. In any event, both device 23 and device 70 can be considered as devices 60 for controlling the power delivered by a user to each footboard 40.

[0025] For simplicity, the detailed descriptions of brake 24 and device 70 are omitted, firstly because both devices are structurally known, and secondly because the embodiment of the present invention is independent of the choice of type of load unit. In any event, in Figure 4 it was thought appropriate to illustrate a portal structure 71 for unit 20 supporting a group 72 of weight packs 73 for each arm 35, each group 72 being vertically actuable under the action of footboards 40 by means of a cable 74.

[0026] Returning to the skating movement, it is worth observing that normally skaters perform a thrust on each foot alternately, and therefore impose an equal pause on each foot. Accordingly, for an effective reproduction of this movement it may be appropriate to exert a return force towards the centre to the inactive footboard 41; machine 1 includes, furthermore, a reaction device 80 visible in Figures 3 and 5, capable of exerting, on each arm 35, a return action directed inwards, and tending to bring each arm 35 back to the central position, and therefore interpretable as a safety device. For choice, this action must have an intensity suitably proportionate to the amplitude of an angle of rotation outwards of each said arm 35, for which reason device 80 must have mechanical characteristics of an elastic type. In this regard, device 80 may have different embodiments, which have in common at least one elastic return unit acting on arms 35 through transmission 21.

[0027] According to the version in Figure 3, reaction device 80 includes at least one belt 82 arranged in an inverted 'U' between arms 35 to connect them together in a substantially rigid fashion, and has relative end sections wound onto shaft 38 in the opposite direction to how each belt 33 is wound onto its respective pulley 34. In this way, belt 82 is capable of being wound onto shaft 38 while belt 33 is unwound through the application of tension to belt 29, during the active stroke of footboard 40. Belt 82 is kept constantly subjected to an action of

traction by means of a pulley 83 which is supported elastically by frame 10 by means of a bracket 84 carried by an arm 85 which is hinged to frame 10 at the opposite end to pulley 83, and restrained elastically by elastic return unit 81 including at least one spring 86, connected to frame 10 by a relative end section. In this case the elastic return force is exerted on each arm 35 by reaction device 80 by means of each spring 86. In this way, upon each displacement outwards of each footboard 40, spring 86 exerts through arm 85 an elastic reaction on the other footboard 40 which is a function of the length of arm 85 and of the elastic constant of elastic return unit 81.

[0028] In virtue of what is described above, device 80, in its diverse variants, is interpretable as a safety device, which makes machine 1 itself usable without risk even by users not trained in the execution of the skating movement, or by users who do not have practice in this movement.

[0029] Furthermore, from the description above, it is easy to understand that on machine 1, similarly to some machines for carrying out the movement of climbing stairs, or steppers, lack of activity by the user leads to a loss of height through gravity. For this reason frame 10 has a front section 11 usefully shaped for allowing a user to lean on during the process of climbing onto and descending from the said machine 1, or for being employed for exerting a bilateral reaction force to the thrust of the legs during training.

[0030] If spring 86 were to be combined with a rigid body 86b of longitudinal extension substantially equivalent to that of spring 86 when undeformed, illustrated alongside spring 86 only in figure 3, it would be possible to prevent the rotation of arm 85 with respect to frame 10, and therefore to restrict the rotation relative to each other of arms 35, making machine 1 of interest for a less expert category of users.

[0031] Finally, it is clear that modifications and variations may be made to machine 1 here described and illustrated without for this reason departing from the protective compass of the present invention.

[0032] Solely for reasons of clarity, machine 1 described above has been described for an active movement for the purpose of delivering power only in the eccentric thrust stroke in which each footboard 40 is thrust outwards, and not active in the act of returning footboard 40 towards the centre, given that this happens during the execution of the skating movement. However, the present invention may also be embodied by means of machines which provide for the absorption of energy also on the stroke which returns footboard 40 towards the centre, for example by adding load units 20 substantially identical with those already installed, but with operation reversed.

[0033] For example, if it were considered necessary to adapt the elastic action exerted by the version described above of device 80 to the characteristics of a user, it is possible to modify device 80 according to the

diagram in Figure 5a, providing for elastic return unit 81 to include a spring 87 for each arm 35, or according to the diagram in Figure 5b, in which device 80 includes a spring 87 for each arm 35 and a spring 88 which is arranged between arms 35 to connect them elastically together. In Figure 5b, spring 88 has, for convenience, been divided into two elastic sections 90 arranged on opposite sides with respect to a pulley 89 carried by frame 10, but could be executed differently without altering its operation.

[0034] The choice of a model of reaction force according to Figure 3, or according to Figures 5a or 5b, will depend on the type of effect which the user believes most satisfactory for his/her type of training, and the set of three alternatives described must not be interpreted as exhaustive of the possible embodiments of reaction device 80, but only as exemplifying the possible embodiments of the said device 80.

[0035] In accordance with what is described above, it must be noted that in machine 1 it is not possible to exclude the possibility of elongated component 51 of each arm 35 being stressed also in flexion rather than by normal stress only. As is well-known, articulated quadrilaterals stably maintain the constancy of the trajectories of their vertices when their shafts are in the condition of operating while subject only to normal stress, and only when this occurs with reference to machine 1 will less trained or practiced users be able to find the use of this machine comfortable and safe. To prevent the trajectories of footboards 40 from undergoing variations which are unpredictable and potentially dangerous for users, machine 1 can be substituted by a machine 101, visible in Figures 7 and 8, in which, in order to distinguish components similar to those already described for machine 1, reference numbers will be used for brevity which differ by 100 from those already used, unless specified otherwise. In particular, machine 101 includes a pair of arms 135 with elbows, each of which is pivoted on a shaft 136 and has, for each relative straight-line stretch, a constraining device 50 having an articulated mechanism analogous to articulated quadrilateral 43. In particular, with reference to Figure 8, each arm 135 has corresponding to it an elbow 137 and two quadrilaterals 153 and 154, capable of cooperating with each other to control the angular position of the respective footboard 140 with respect to the corresponding arm 135 by means of a common lever 157. This lever 157, which is a connecting rod for quadrilateral 154 and is a crank for quadrilateral 153, is carried freely rotatably by the relative arm 135 in proximity to the corresponding elbow 137. At this point, for completeness, it may be verified that, with reference to figure 8, quadrilateral 153 shares with machine 1 the respective frame 110, while the frame of the second quadrilateral 154 is constituted by the respective arm 135. Furthermore, still with reference to these figures, quadrilateral 153 includes an elongated component 155, capable of functioning as a connecting rod, and quadrilateral 154 includes, in its turn, an elongated

component 156 which functions as an equaliser. Components 155 and 156 are delimited by respective spherical joints 152 and, analogously with component 51, can have adjustable lengths to allow adjustments to the movement of the respective footboard 140 and of the respective upper face 141.

[0036] In this case also, each component 155/156 is capable of producing a composite movement of the respective footboard 140 and in particular of inclining the respective footboard 140 inwards during the outwards thrust stroke of the relative arm 135, and simultaneously of rotating footboard 40 forwards, to lower its front section 144 and simultaneously raise its rear section 145.

[0037] Machine 101 includes, furthermore, a reaction device 180, the double of device 80 already described with reference to machine 1, and this is similarly interpretable as a safety device. In particular, with reference to Figure 7, machine 101 has a mechanical transmission 121, which is placed between load unit 120 and exercise station 130, and is capable of transforming an alternating rotary movement of each arm 135 into a rotation of a flywheel 125. This transmission 121 includes, by analogy with machine 1, at least one belt 133 for each arm 135, and each belt 133 is wound onto a free wheel 134 carried by a shaft 138 through the interposition of a single pulley 122 supported by the frame 110 below shaft 138. Each wheel 134 is keyed onto shaft 138 alongside flywheel 125 to transmit motive torque to the said flywheel 125, which is mechanically connected to a brake 124 through the interposition of a coupling 139 with parallel axes. It may be observed that machine 1 and machine 101 differ also by the fact that transmission 21 and transmission 121 have respectively one stage and two stages of parallel-axis couplings. In the case of machine 101, this allows the use of a brake 124 which can rotate much more quickly than brake 24, and can therefore be much more accurately controllable.

[0038] Still with reference to Figure 7, reaction device 180 has an elastic return component 186 for each arm 135, tending in use to bring the relative arm 135 back to its respective rest position R. Each component 186 is actuated preferably, but not limitingly, by a large-diameter torsion spring, and the two springs 186 are carried coaxially to each other by frame 110 below pulleys 122 between shaft 138 and brake 124 between shaft 138 and brake 124. According to Figure 7, the solution of large-diameter torsion springs 186 contributes to reducing considerably the longitudinal dimensions of machine 101, with the advantage of greater rigidity and less bulk for the said machine. Device 180 is therefore as a result more compact than device 80 of machine 1.

[0039] In addition, device 180 includes a further elongated component 195 which, as appears from figure 8, is arranged between arms 135 to connect them to each other and, as will appear from the description which follows, has a length variable as a function of the force exerted on footboards 140, in such a way as to bring about a constraining action in proportion to the angular

distance between the two arms 135. With reference to Figure 9, component 195 is constructed substantially as a damper and, according to Figure 8, is connected to each arm 135 by relative articulated end sections 152.

In particular, component 195 includes a casing 198 which houses a rod 199 in axially free manner and casing 198 and rod 199 are connected to each other by a pair of first springs 196 and 197 of different and fixed elastic constant. Spring 196 has the lower elastic constant, and springs 196 and 197 are arranged in series with each other and are capable of functioning as a single elastic body with a fixed value for shortening of the damper up to the point when rod 199 is in its end-of-stroke position inside casing 198, and springs 197 and 196 are coilbound. In virtue of what is described above, component 195 is designed to react principally through spring 196 of lower elastic constant for small angles of relative rotation between the two arms 135, while component 195 is designed to react only through spring 197 for large angles of relative rotation between the two arms 135. In this event the angular distance between arms 135 is at its maximum, component 195 is equivalent to a rod of fixed length, the two arms 135 are rigidly related to each other, and can therefore rotate through equal angles in equal times. In this event, the operation of one footboard 140 causes the operation of the other in dual manner. If this was a desired objective, it would then be possible to think of replacing component 195 with a rigid rod, even though this could entail operational problems in the initial transitory stage, because of the fact that a user would have to start the exercise with the footboards at minimum distance from each other, and therefore in precarious conditions of static equilibrium.

[0040] For this reason, component 195 is capable of imposing compliance on footboards 140 with a minimum distance between them when the relative arms 135 are in their respective rest positions or, in use, are placed in proximity to plane L, and of preventing the amplitude of the angle between arms 135 from exceeding a fixed value which may be established by means of known and not illustrated devices for calibrating springs 196 and 197 and the minimum length specified for component 195, in such a way as to ensure that a user is maintained in conditions of equilibrium.

[0041] From the description given above, it may clearly be deduced that machine 101 also represents an embodiment of the inventive concept described above, and is such as to represent a valid solution to the technical problems illustrated above, being as a result particularly uncumbersome and safe even for users little trained or expert in skating.

Claims

1. A gymnastic machine (1)(101) having a frame (10) (110) supporting a load unit (20)(120) and an exercise station (30)(130) capable of exchanging me-

chanical energy with said load unit (20)(120) and having at least one pair (31) of mechanical components articulated together, among them an arm (35) (135) carried rotatably by said frame (10)(110) around a fixed axis (36)(136) and an implement (40) (140) coupled rotatably to said arm (35)(135); said implement (40)(140) being shaped in such a way as to be interfaceable with a particular portion of an extremity of a user and being movable over an open trajectory P; said exercise station (30)(130) including means of constraint (50)(150) supported by said frame (10)(110) and associated with each of said pairs (31) to control the rotation of said implement (40)(140) with respect to the relative said arm (35) (135); **characterised by** the fact that said means of constraint (50)(150) include at least one elongated component (51) (155, 156) coupled to said frame (10)(110) and to said implement (40)(140) by respective joints (52)(152), in such a way that, in use, said implement (40)(140) is movable along said trajectory (P) according to a composite movement when said arm (35)(135) is actuated outwards; said composite movement being a combination of an inclination movement inwards of said implement (40) (140), to reduce varus of the knee and favour the stability of the ankle, and of a forward rotation of the footboard (40)(140), with lowering of a respective front portion (44) and, simultaneously, raising of a respective rear portion (45)(145), to stabilise the centre of gravity of a user.

2. A machine according to claim 1, **characterised by** the fact of including at least two pairs (31) and by the fact that said trajectories (P) of said implements (40) are substantially symmetrical and concurrent with each other; said joints (52) being skew to each other; said composite movement of said implement (40) being similar to a movement of eversion of a human foot.
3. A machine according to claim 2, **characterised by** the fact that said means of constraint (50)(150) include, for each said arm (35)(150), at least one first articulated quadrilateral (43)(153)(154) including every said elongated component (51)(155)(156) to control the angular position of respective said implement (40)(140) with respect to the arm itself (35) (135); said first quadrilateral (43)(153) being supported by said frame (10)(110).
4. A machine according to claim 3, **characterised by** the fact that each said first articulated quadrilateral (43)(153)(154) includes, for each said arm (35) (135), at least one elongated component (51)(155) (156) coupled to said frame (10)(110) and/or to said implement (40)(140); each said elongated component (51)(155)(156) being delimited longitudinally by respective articulations (52)(152); and that each

said composite movement is capable of simulating an eversion of a human foot.

5. A machine according to claim 4, **characterised by** the fact that said trajectory (P) is inclined downwards.
6. A machine according to any of the preceding claims, **characterised by** the fact that each said implement (40)(140) includes a footboard (40)(140) delimited on its upper side by an upper face (41) (141) profiled in such a way as to receive the sole of a user's foot; said footboard (40)(140) being capable, in use, of operating as a lever for the corresponding said first quadrilateral (43)(153) according to a modality of operation in which the sole of a user's foot and said upper face (41)(141) are constantly in reciprocal contact in conditions of rest, to exploit to the full a movement of outward thrust exerted by the said user on each said arm (35)(135).
7. A machine according to claim 5 or 6, **characterised by** the fact that for each said arm (135) the said means of constraint (150) comprise a second articulated quadrilateral (154); said first and second quadrilaterals (153)(154) sharing one of their respective levers (157) for controlling the angular position of the relative said footboard (140) with respect to the corresponding said arm (135) by means of a first and second elongated components (155) (156) subjected to only normal stress.
8. A machine according to claim 7, **characterised by** the fact that said second quadrilateral (154) is supported by the respective said arm (135).
9. A machine according to claim 8, **characterised by** the fact that a connecting rod (157) of said first quadrilateral (153) is capable of acting as a moving component for said second quadrilateral (154).
10. A machine according to any of the preceding claims, **characterised by** the fact that each said arm (35)(135) is carried rotatably by said frame (10) (110) in such a way as to be capable of crossing a longitudinal median plane (L) starting from a rest position (R) in which the respective said footboard (40)(140) is arranged on the side opposite to the respective shaft (36)(136) with respect to said plane (L), in such a way as to render said station (30)(130) more compact.
11. A machine according to any of claims 4-10, **characterised by** the fact that each said elongated component (51)(155)(156) has adjustable longitudinal extension, in such a way as to allow adjustments to the movement of the respective said footboard (40) (140) with respect to the relative arm (35)(135).

12. A machine according to any of the preceding claims, **characterised by** the fact that means of reaction (80)(180) are provided for exerting a return action on each of the said arms (35)(135) towards a respective rest position (R), in proximity to said longitudinal plane (L). 5
13. A machine according to claim 12, **characterised by** the fact that the means of reaction (80)(180) include, for each said arm (35)(135), at least one elastic component (81)(86)(87)(186) arranged between said frame (10)(110) and the arm itself (35)(135) tending to bring each of the said arms (35)(135) into the respective rest position (R). 10
14. A machine according to claim 12 or 13, **characterised by** the fact that said means of reaction (180) include an elongated component (195) arranged between said arms (135) and shaped in such a way as to bring about a constraining action between them as a function of their reciprocal angular distance, and such as to impose on said footboards (140) compliance with a minimum distance between them when the respective said arms (135) are in their respective rest positions (R) or, in use, are in proximity to said longitudinal plane (L), and such that the amplitude of the angle between said arms (135) exceeds a fixed value, in such a way as to ensure that a user is maintained in conditions of equilibrium. 15 20 25 30
15. A machine according to claim 14, **characterised by** the fact that the said second elongated component (195) is connected to each said arm (135) by means of the articulated relative end sections (152) and includes a pair of first springs (196, 197) arranged in series and of different and fixed elastic constant. 35
16. A machine according to any of claims 12-15, **characterised by** the fact that each said second return component (186) includes a torsion spring (186). 40
17. A machine according to claim 13, **characterised by** the fact that said means of reaction (80) include, furthermore, at least one flexible restraining component (82) arranged between said arms (35), kept constantly in tension in elastic manner with respect to said frame (10) by means of each of the said first return components (81)(86) in order to modulate said return action exerted on each of said arms (35), towards the corresponding rest position (R), on the basis of outward thrusts exerted on each footboard (40). 45 50
18. A machine according to claim 17, **characterised by** the fact that said flexible restraining component (82) is wound onto a pulley (83) carried by a tensioning arm (85), and that the latter is connected to said frame (10) by means of each of the said first return components (81)(86). 55
19. A machine according to claim 13, **characterised by** the fact that said means of reaction (80) include at least one third return component (87) for each of the said arms (35).
20. A machine according to claim 19, **characterised by** the fact that said means of reaction (80) include, furthermore, a second spring (88) arranged between the two said arms (35) to connect them elastically to each other in direct manner.
21. A machine according to any of claims 5-20, **characterised by** the fact that the trajectories (P) of said implements (40)(140) are substantially symmetrical and include at least one stretch in common; said arms (35)(135) being shaped dissimilarly from each other, in such a way as to prevent, in use, collisions between said implements (40)(140).
22. A machine according to any of the preceding claims, **characterised by** the fact that said load unit (20)(120) and said exercise station (30)(130) are connected to each other mechanically by means of a mechanical transmission (21)(121) by belt, capable of transforming an alternating rotary motion of each said arm (35)(135) into a rotation of at least one rotatable component (25)(22)(125)(122); said mechanical transmission (21)(121) including at least one belt (33)(133) for each of the said arms (35)(135); each of the said belts (33)(133) being wound onto at least one pulley (22)(122) supported by said frame (10)(110) in freely rotatable manner between the corresponding said arm (35) and said load unit (20)(120).
23. A machine according to any of the preceding claims, **characterised by** the fact that said load unit (20) includes means (60) of controlling the power delivered on each of said implements (40).
24. A machine according to claim 23, **characterised by** the fact that said rotatable component (25)(125) is shaped in such a way as to be suitable for storing rotational energy, and is mechanically connected to a component (24)(124) capable of dissipating adjustable values of power.
25. A machine according to claim 24, **characterised by** the fact that said rotatable component (25)(125) includes a flywheel (25)(125).
26. A machine according to claim 25, **characterised by** the fact that said means (60) of controlling power delivered on each of the said implements (40) include an electromagnetic brake (24).

27. A machine according to claim 26, **characterised by** the fact that said load unit (20) has at least one load group (70) with counterweights.

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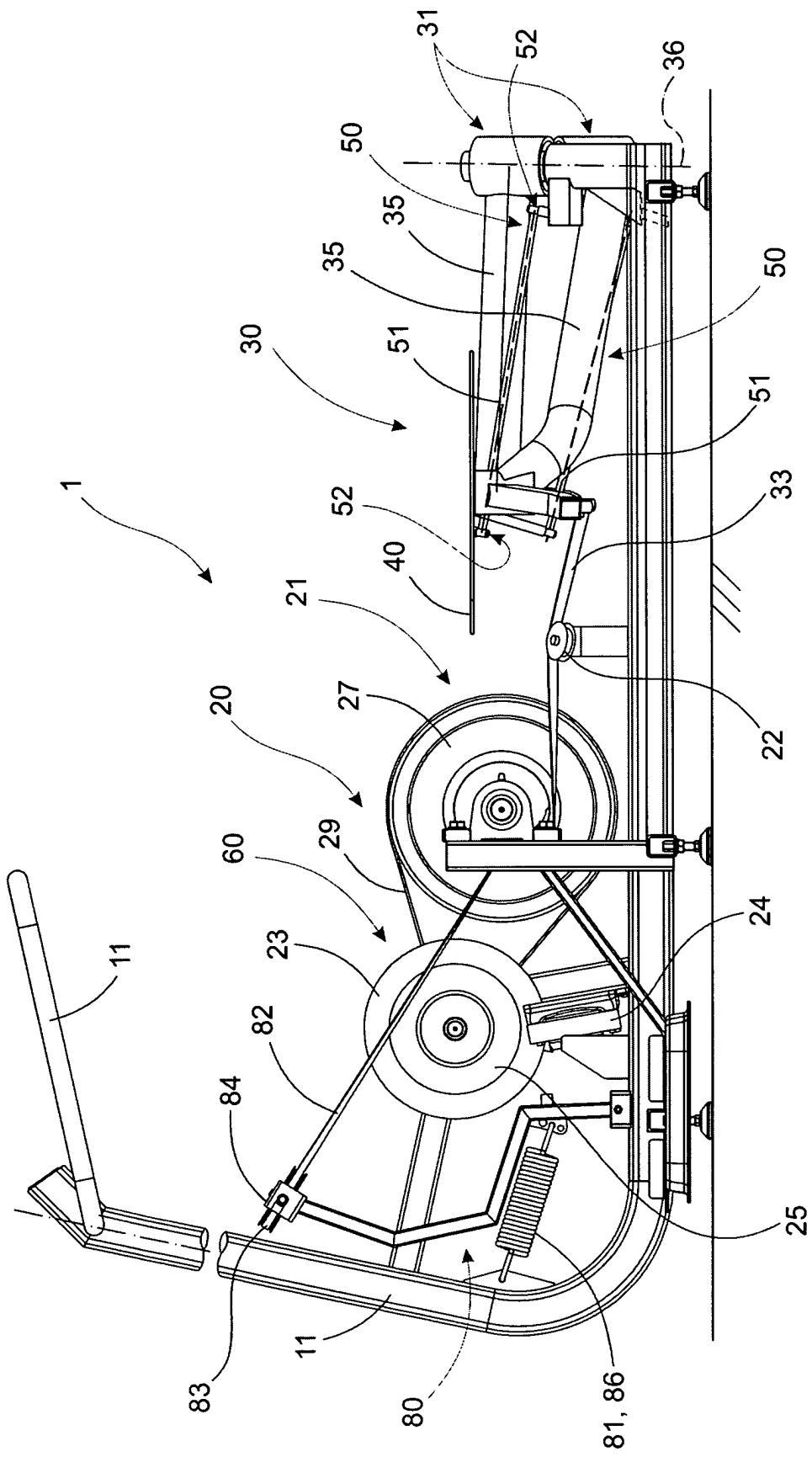
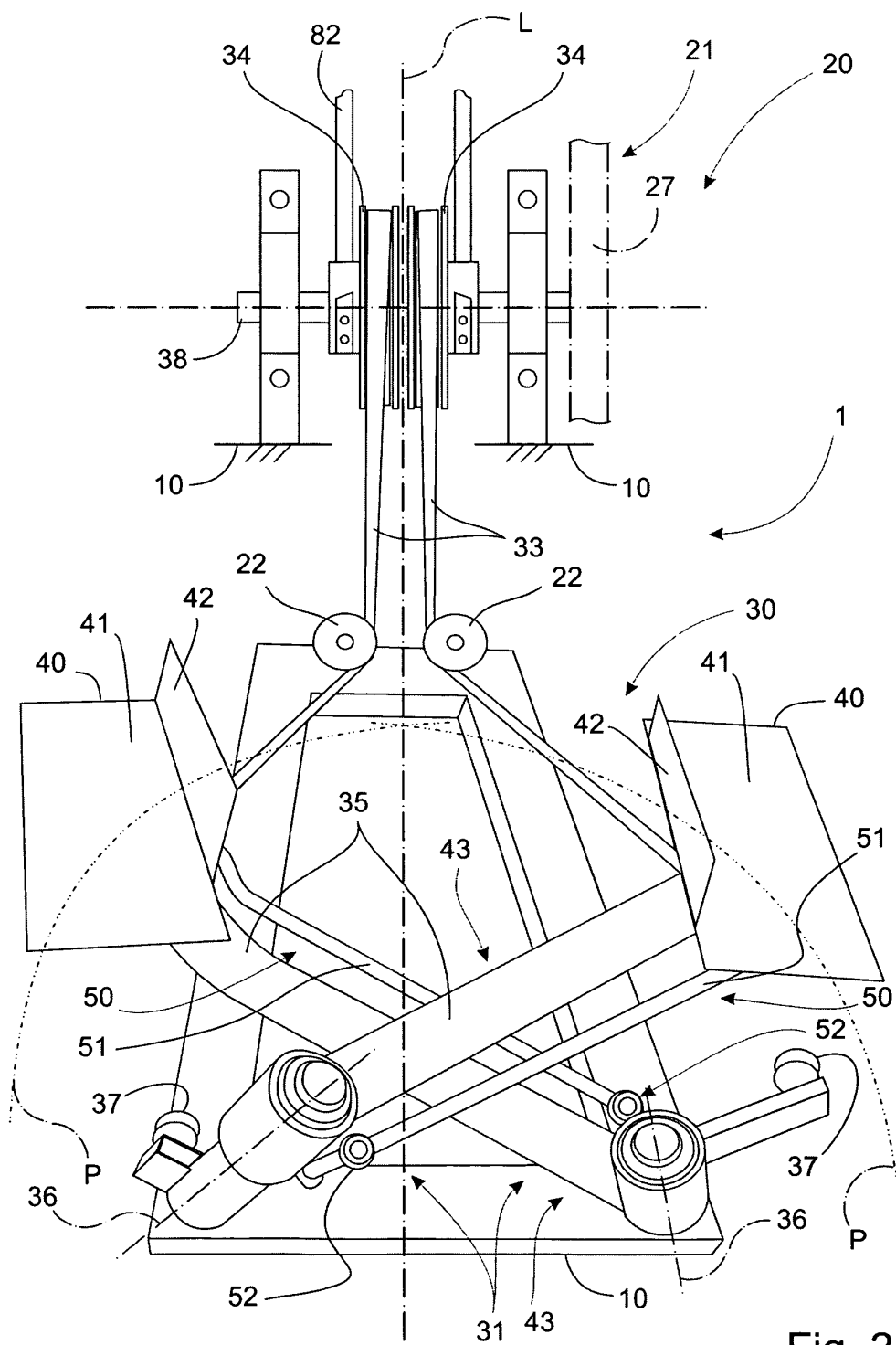
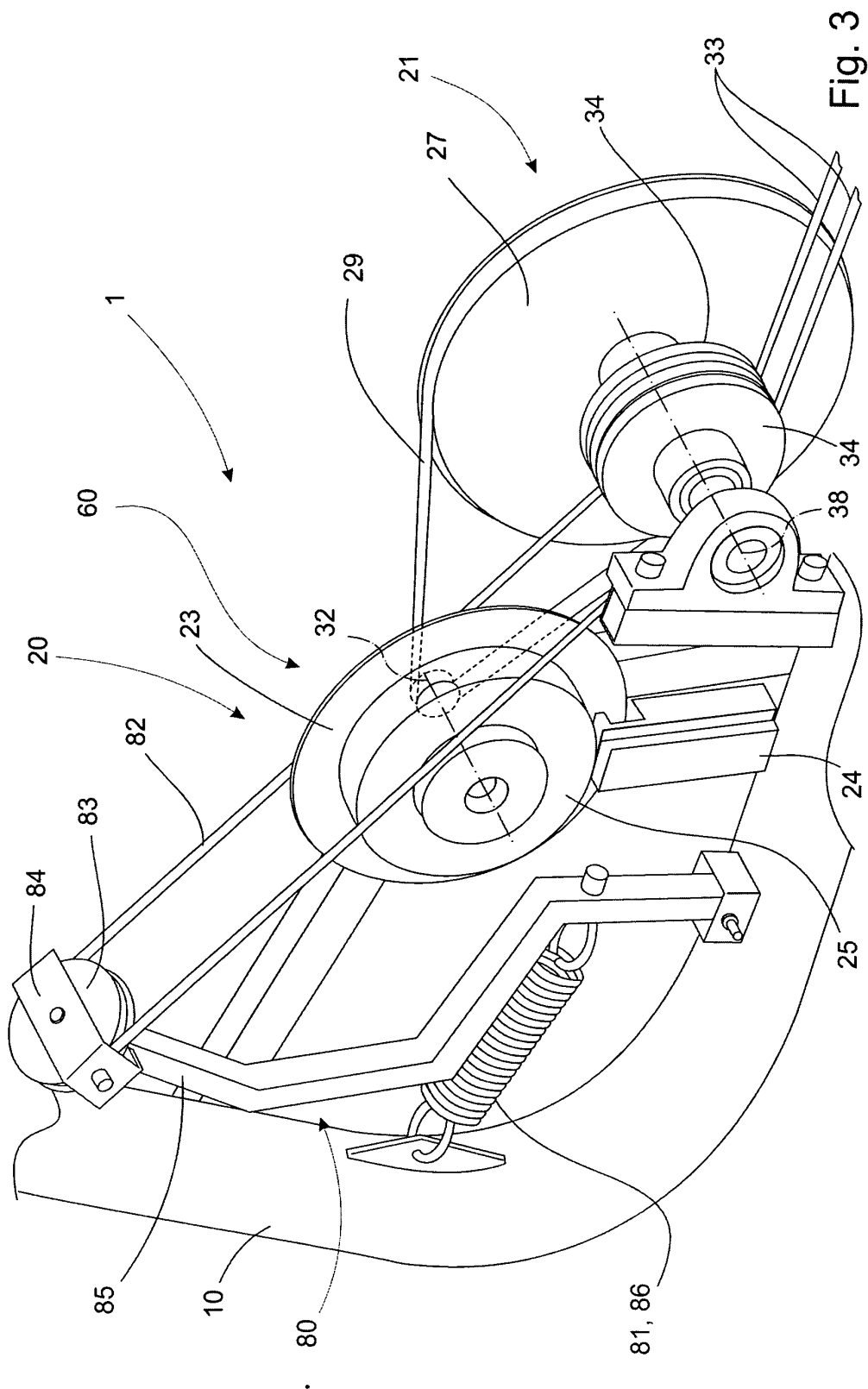
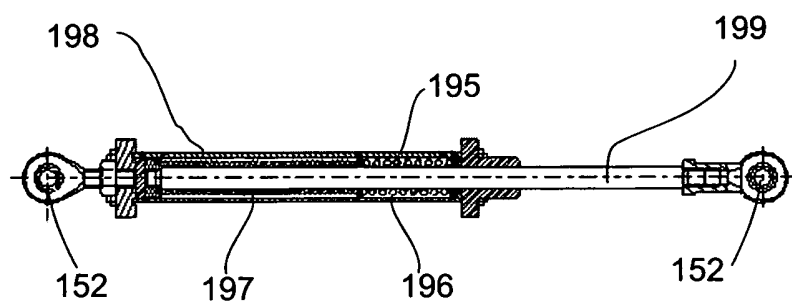
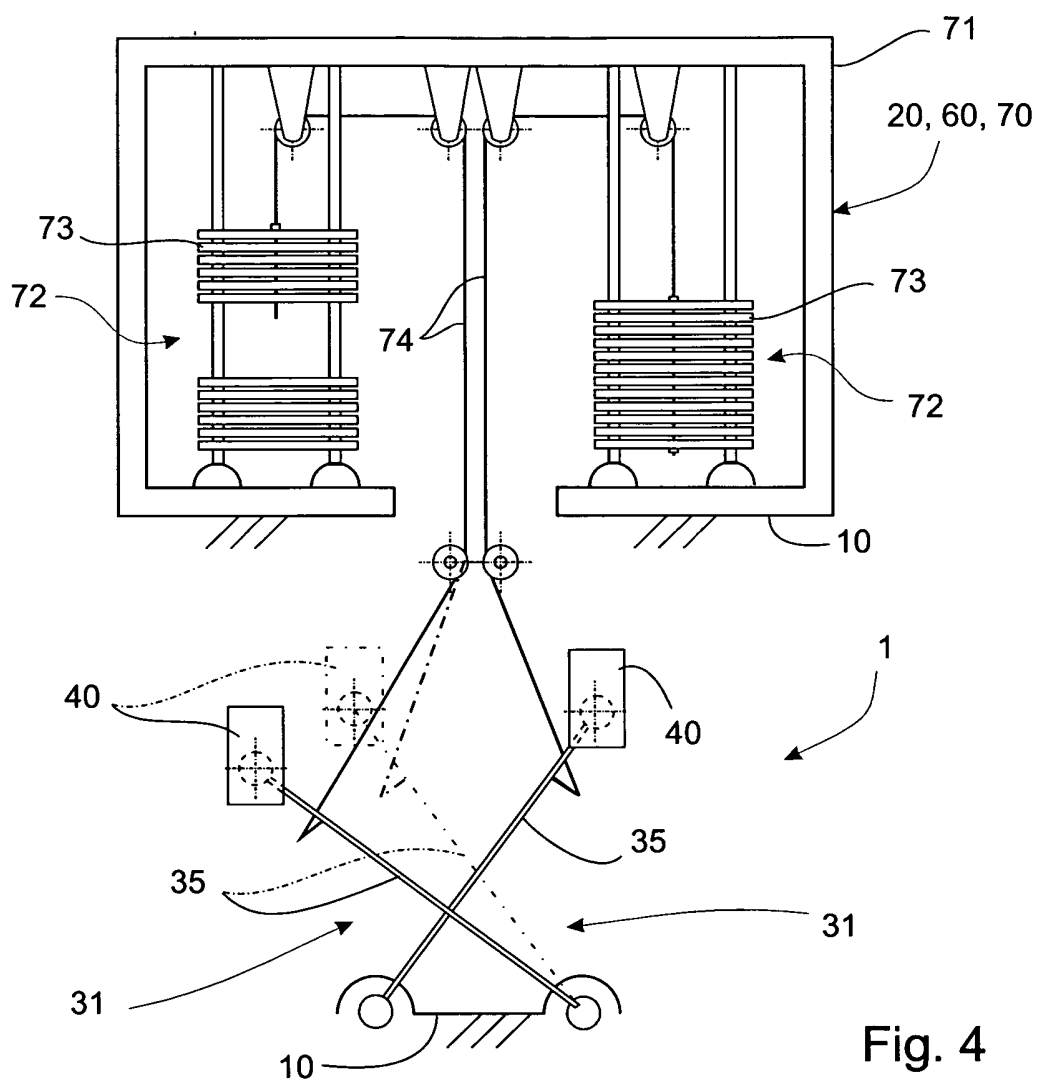
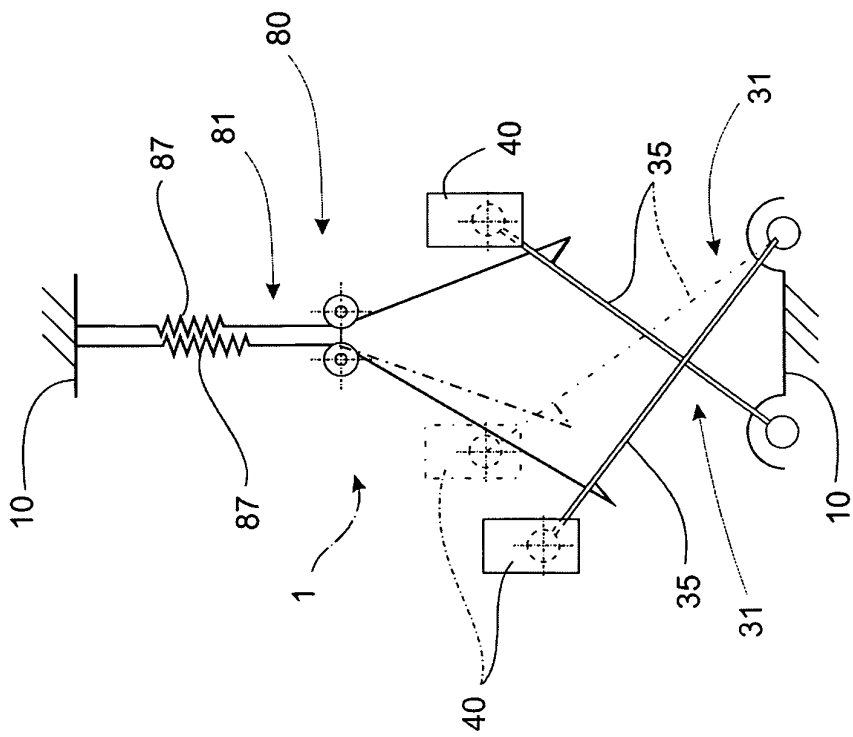
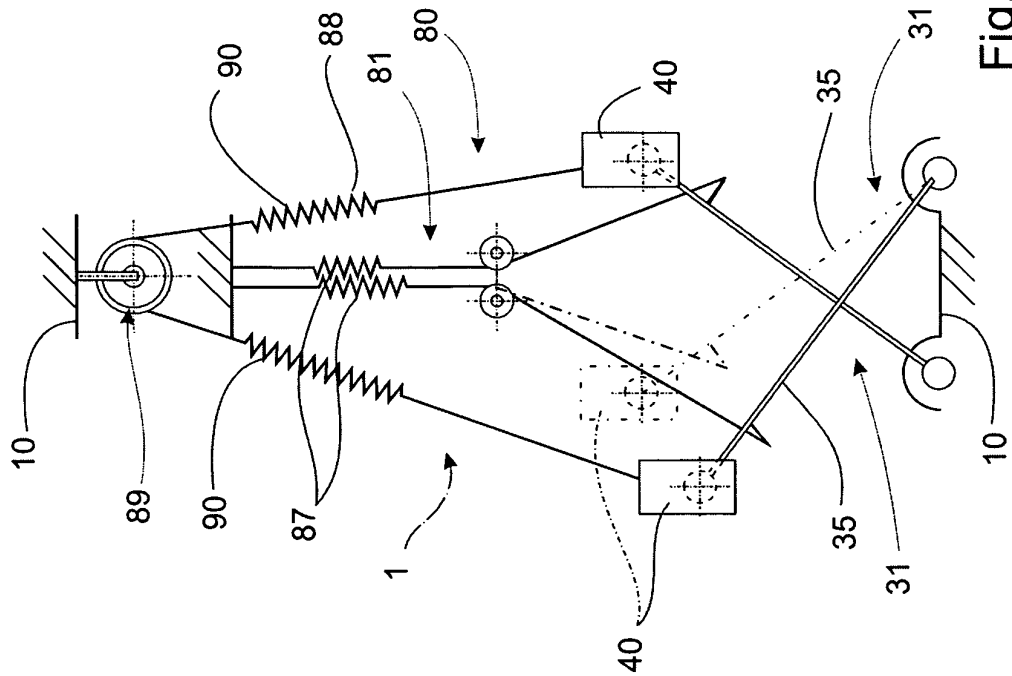


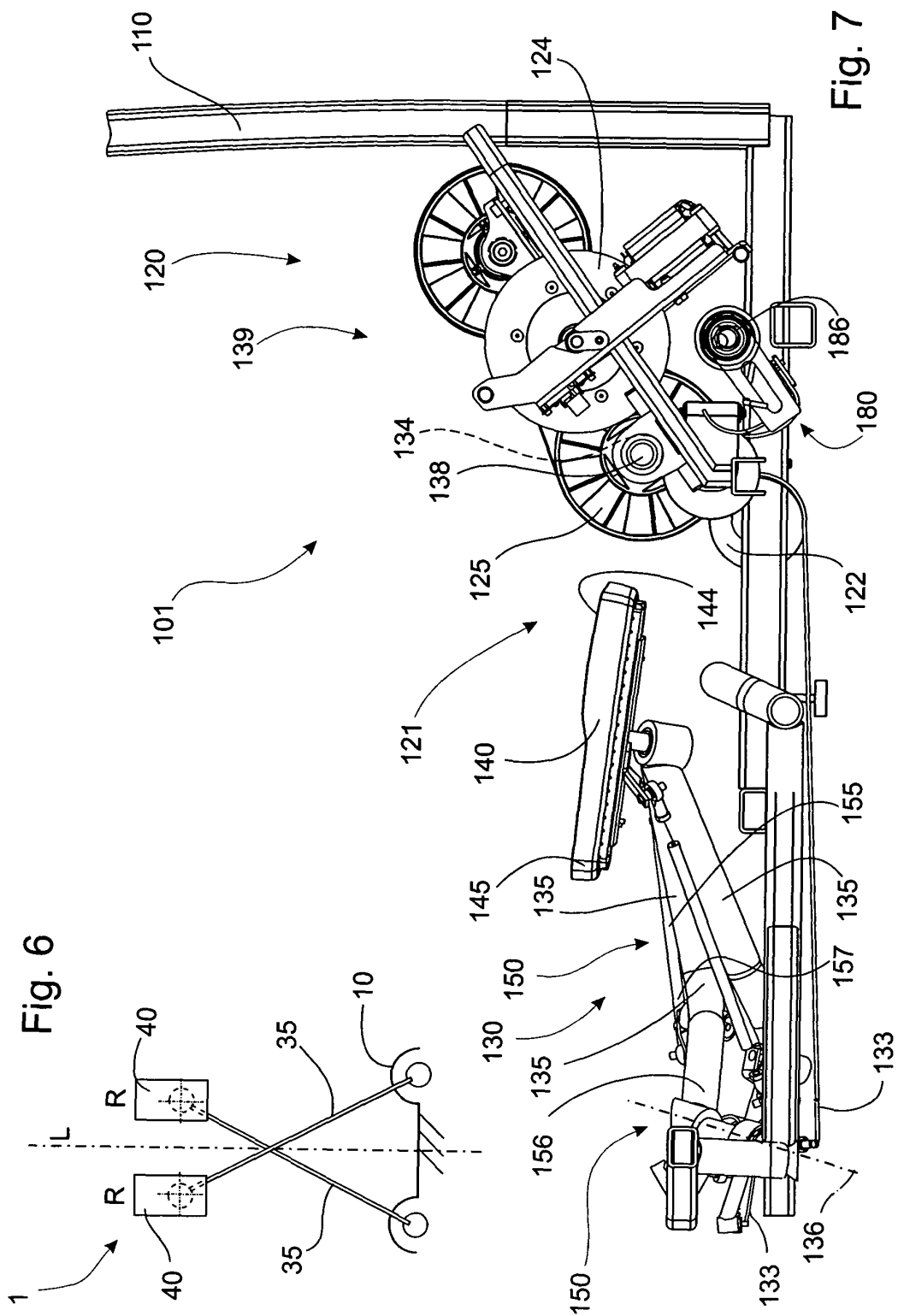
Fig. 1











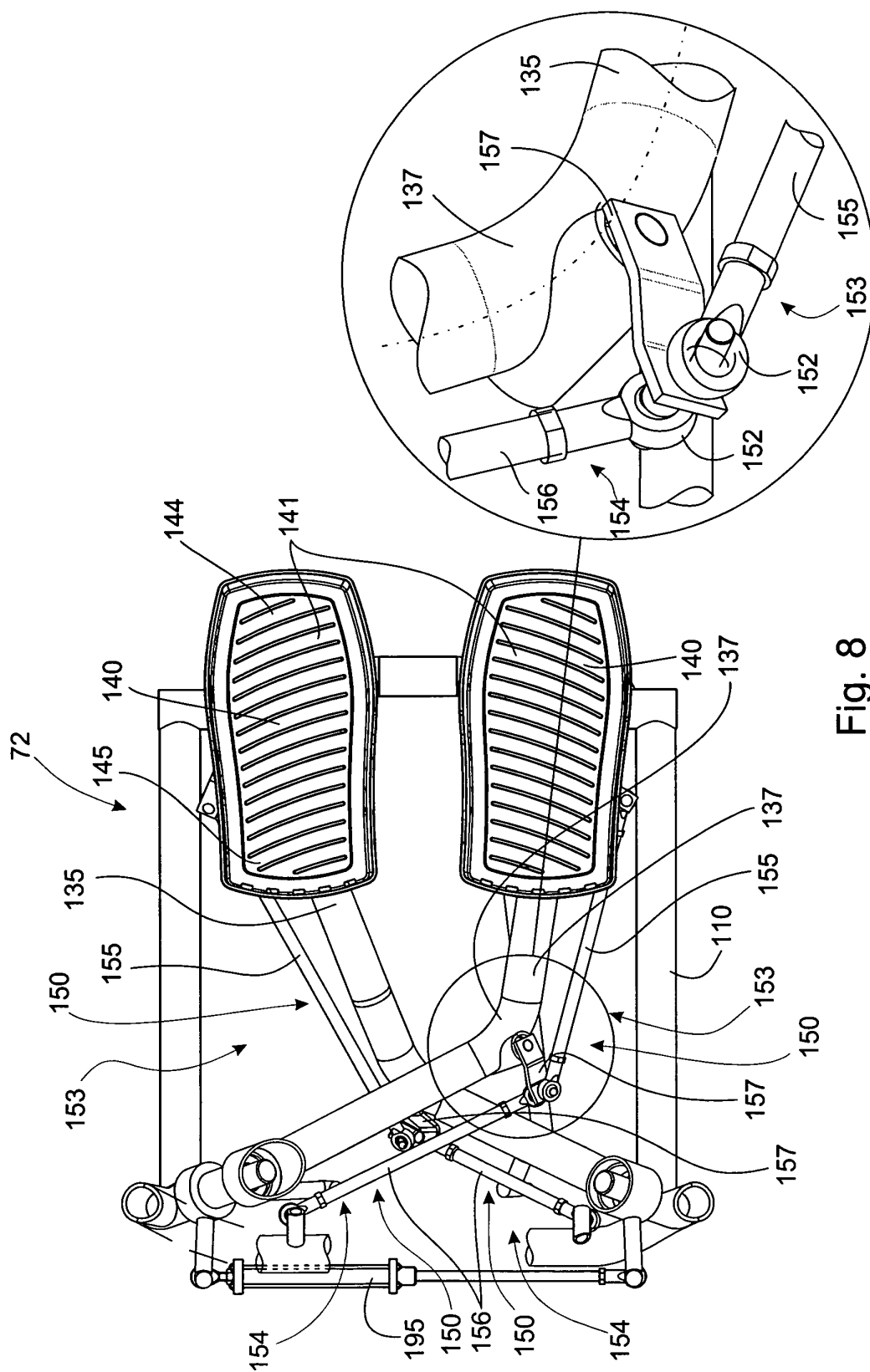


Fig. 8